

# Consequences in Georgia of a Nationwide Outbreak of *Salmonella* Infections: What You Don't Know Might Hurt You

## ABSTRACT

**Objectives.** This study assessed the impact in Georgia of a nationwide salmonellosis outbreak caused by ice cream products and the effectiveness of the subsequent warning against eating the implicated products.

**Methods.** A telephone survey of 250 randomly selected Georgia customers of the ice cream producer was conducted 13 to 17 days after the warning.

**Results.** Respondents from 179 households representing 628 persons were interviewed. The median date of first hearing the warning was 5 days after it was issued, and 16 respondents (9%) had not heard it. Among those who had heard the warning, 42 (26%) did not initially believe the products were unsafe. In 22 (31%) of the 72 households that had the implicated ice cream when the respondent heard the warning, someone subsequently ate the ice cream. Diarrhea was reported in 26% (121/463) of persons who had eaten the products but in only 5% (8/152) who had not (odds ratio [controlling for household clustering] = 3.8; 95% confidence interval = 2.0, 7.5). We estimate this outbreak caused 11 000 cases of diarrhea in Georgia, 1760 (16%) with exposure after the warning.

**Conclusions.** A large outbreak occurred in Georgia, much of which might have been prevented by a more timely and convincing warning. (*Am J Public Health*. 1999;89:31-35)

Barbara E. Mahon, MD, MPH, Laurence Slutsker, MD, MPH, Lori Hutwagner, MS, Cherie Drenzek, DVM, Kathleen Maloney, Kathleen Toomey, MD, MPH, and Patricia M. Griffin, MD

Widespread outbreaks of foodborne illness are a growing threat to public health in the United States. Increasingly, foods are produced in enormous volumes in central locations and then distributed widely; contamination during production can cause large outbreaks of foodborne illness.<sup>1-4</sup> Such outbreaks present many challenges, including informing the at-risk public about how to avoid illness and retrieving the contaminated food for safe disposal. Generally, the public is informed through the news media, and contaminated food is retrieved through product recalls. However, evaluating the effectiveness of these measures for products that have already been purchased is difficult because the identity of consumers who have the products at home is rarely known.

A recent nationwide outbreak of *Salmonella* serotype Enteritidis infections caused by commercially produced ice cream<sup>5</sup> exemplifies both the trend toward widespread outbreaks and the challenge of preventing additional illnesses after a vehicle has been identified. In early October 1994, the Minnesota Department of Health determined that ice cream manufactured in Marshall, Minn, by Schwan's Sales, Inc, and distributed through a route driver system directly to households in the continental United States was responsible for an outbreak of *Salmonella* serotype Enteritidis infections. The source of contamination was probably tanker trucks that delivered ice cream premix to the factory for freezing; starting in July 1994, these trucks also routinely hauled liquid raw eggs, a common source of *Salmonella* serotype Enteritidis.<sup>6</sup>

This outbreak was the largest common-vehicle *Salmonella* outbreak ever recognized in the United States; 41 states reported outbreak-related cases, and the total number of cases was estimated at 224 000.<sup>5</sup> After the vehicle was identified, public health officials

and Schwan's attempted to warn customers. Schwan's mailed letters about the outbreak and recall of implicated products to customers. Schwan's home delivery drivers were instructed to collect these products from customers. The first press release about the outbreak was issued on October 7, beginning several weeks of nationwide media coverage.

Because Schwan's distributes directly to households, customer lists were available. Thus, unlike the usual situation, the identity of consumers who may have had the contaminated products at home was known. This situation was an opportunity to investigate when and how at-risk persons heard the warning that the implicated ice cream should not be eaten and whether they heeded the warning. We describe an investigation in Georgia of the impact of the warning on Schwan's customers, the magnitude of the outbreak, and the content and timing of news reports about the outbreak. We use "the warning" to mean any information about the outbreak available to at-risk customers and restrict "the outbreak" to the actual diarrheal illnesses constituting the outbreak.

At the time of the study, Barbara E. Mahon, Laurence Slutsker, Cherie Drenzek, and Patricia Griffin were with the Foodborne and Diarrheal Diseases Branch, Centers for Disease Control and Prevention (CDC), Atlanta, Ga. Dr Mahon is now with the Department of Pediatrics, University of Medicine and Dentistry of New Jersey-Robert Wood Johnson Medical School, New Brunswick, NJ. Lori Hutwagner and Kathleen Maloney are with the Biostatistics and Information Management Branch, CDC, Atlanta, Ga. Kathleen Toomey is with the Georgia Department of Human Resources, Atlanta.

Requests for reprints should be sent to Laurence Slutsker, MD, MPH, Foodborne and Diarrheal Diseases Branch, Mailstop A-38, Centers for Disease Control and Prevention, 1600 Clifton Rd, Atlanta, GA 30333.

This paper was accepted June 18, 1998.

## Methods

### *Survey of Customer Households*

We conducted a survey of 250 randomly selected Schwan's customers in Georgia, 1% of those in the state, to determine when and how customers heard the warning and the incidence and correlates of diarrheal illness. We telephoned customers between October 20 and 24, 13 to 17 days after the warning was first issued. Eligible customers were households (businesses were excluded) that had purchased any Schwan's products since July 1, 1994, the beginning of the likely period of contamination. An eligible respondent was the person on the customer list or another person aged 18 years or older who lived in the household and who knew which Schwan's products had been purchased for the household.

Implicated products were defined as the recalled ice cream, frozen yogurt, sherbet, and ice cream novelty products that were manufactured in Schwan's Marshall, Minn, factory. We used a questionnaire to ask which Schwan's products had been purchased for the household since July 1, and, regarding the warning, whether the respondent had heard it ("Have you heard about a problem with Schwan's ice cream products?") and, if so, when, how, and what the respondent understood the warning to mean (whether he or she thought the implicated products were "OK to eat"). We also asked the respondent about each household member's history, since July 1, of consumption of Schwan's ice cream products, diarrhea (defined as 3 or more loose or watery stools in a 24-hour period), and other symptoms.

We estimated the number of potentially exposed Georgians—those who may have eaten implicated products—by multiplying the number of Schwan's Georgia customers by the proportion of customers that represented households that bought implicated products and then by the mean number of persons in those households who ever ate Schwan's ice cream. We estimated the impact of the outbreak in Georgia by multiplying the excess diarrhea rate among household members who ate implicated products (compared with those who did not) by the estimated total number of potentially exposed Georgians. We estimated the proportion of illness due to exposure after the warning as the proportion of diarrheal illnesses among household members who ate implicated products with onset after October 10 (3 days after the first press release; the usual incubation period for *Salmonella* illness is 1 to 2 days<sup>7</sup>) and the number due to exposure after the warning as this proportion

multiplied by the estimated number of outbreak-related illnesses in Georgia.

### *Examination of Media Reports*

To obtain news reports on the outbreak, we searched the NEXIS database (Reed Elsevier, Inc, New York, NY), a news information service including regional, national, and international newspapers, news wires, and magazines, for reports mentioning "ice cream" and also "*Salmonella*" or "Schwan's" from October 7, the date of the first press release, through October 19, the day before our survey began. We selected all reports distributed in Georgia, including national news wire services, summaries of national television and radio news programs and television news programs from two Georgia stations, and articles in nationally distributed newspapers and in the *Atlanta Journal/Constitution*, which is distributed statewide. The NEXIS database does not include strictly local radio, television, and newspapers. For each report, we determined whether it said that implicated Schwan's products should not be eaten and what customers with these products should do with them.

### *Statistical Analysis*

We analyzed the data in Epi Info, version 6.<sup>8</sup> To control for household clustering of diarrheal illness, the association between reported diarrhea and potentially explanatory variables—including whether the respondent had heard the warning, whether the ill household member had eaten implicated ice cream, and household membership—was analyzed in SAS,<sup>9</sup> using the set of generalized estimating equations (GEE) described by Liang and Zeger.<sup>10</sup> Interactions among explanatory variables were also examined.

## Results

### *Survey of Customer Households*

**Population.** We contacted 211 (84%) of the 250 selected customers and interviewed respondents for 179 households (85%; 31 customers were ineligible and 1 refused). The 179 households had 628 household members, a mean of 3.5 (median 3, range 1–8) persons per household, and represented 63 of Georgia's 159 counties. Of these 179 households, 157 (88%) had purchased implicated products, and 473 (85%) of the 554 members of these households had eaten implicated products.

**Warning.** Respondents for 16 (9%) of the 179 households had not heard anything about the warning before our interview. Of the 163

respondents who had heard the warning, 124 (76%) remembered when they had first heard it; the median time was 5 days after the first press release (Figure 1). Television news was the first medium to reach most respondents, although word of mouth from friends or family members was also important (Table 1). Although Schwan's reported mailing letters to all customers and instructing all drivers to collect implicated products, only 21% and 50% of respondents said they had ever been contacted by these means, respectively.

After first hearing the warning, 42 (26%) of the 163 respondents thought the implicated products were "OK to eat," and 16 (10%) were not sure; only 10 (17%) of these 58 respondents had since decided they were not "OK to eat." In 22 (31%) of the 72 households in which implicated products were present when the respondent first heard the warning, a household member subsequently ate the product; 20 (91%) of these respondents said that the household member had not believed there was actually a problem with the ice cream. Among the 157 households that had bought implicated products, 38 (26%) of the 144 whose respondents had heard the warning still had the product, compared with 3 (23%) of the 13 whose respondents had not heard. Similarly, 9 (27%) of the 33 households whose respondents reported receiving a letter from Schwan's still had the product, compared with 28 (26%) of the 109 households that did not receive a letter. However, only 10 (14%) of the 70 that had heard the warning from a driver still had the product, compared with 27 (38%) of the 72 that had not heard from a driver (relative risk = 0.38,  $P < .01$ ).

**Illness.** Respondents reported diarrhea status for 615 (98%) of the 628 household members; 129 (21%; median age 32 years, range 7 months to 72 years) had reportedly had diarrhea since July 1, with a 2-day median duration. Other symptoms included abdominal cramps (65%), headache (50%), nausea (46%), fever (36%), vomiting (33%), and bloody stool (3%). Only 9 of these household members (7%) had sought medical attention, and none had been hospitalized or had had a stool specimen cultured.

Household members who had eaten implicated products were more likely to have been reported with diarrhea than those who had not eaten implicated products (121/463 [26%] vs 8/152 [5%]; GEE odds ratio [controlling for household clustering] = 3.8; 95% confidence interval = 2.0, 7.5). Reported diarrhea rates among members of households that had heard the warning (109 [27%] of 409 exposed vs 7 [5%] of 138 unexposed) were similar to rates among members of households that had not (12 [22%] of 54 exposed vs

1 [7%] of 14 unexposed). Similarly, in the GEE model, eating implicated products was independently associated with reported diarrhea, whereas the respondent's having heard the warning was not. Illness onset dates were reported for 85 household members who had eaten implicated products (Figure 2); 14 of these illnesses (16%) began after October 10, which was 3 days after the first press release.

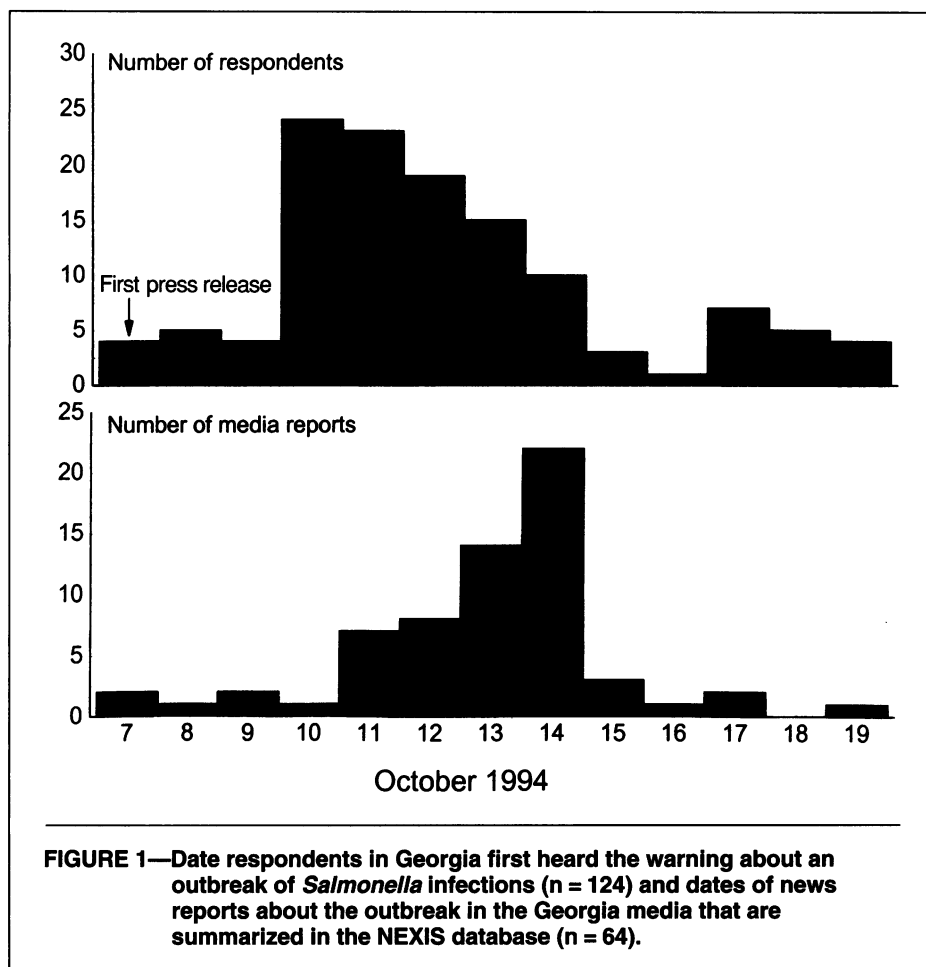
We estimate that about 51 000 Georgians may have eaten implicated products (approximately 23 000 Schwan's customers  $\times$  85% that were eligible households  $\times$  88% that bought implicated products  $\times$  3.5 persons per household that bought implicated products  $\times$  85% of members of those households who ate Schwan's ice cream) and that about 11 000 illnesses occurred as a result of this outbreak (51 000 persons  $\times$  21% [26% diarrhea rate among exposed persons minus 5% diarrhea rate among unexposed persons]). About 1760 cases could have been due to exposure after the warning (11 000 cases  $\times$  16% with onset after October 10) and therefore might have been prevented by a completely effective warning.

#### Examination of Media Reports

From October 7 through October 19, a total of 64 news reports on the outbreak appeared in Georgia in sources listed in NEXIS. The median report date, October 13, was 6 days after the warning was issued (Figure 1). Only 4 reports (6%) said that implicated products should not be eaten. Thirty-one reports (48%) said something about what customers who had implicated products at home should do with them, usually by referring to Schwan's product collection efforts.

#### Discussion

This study documents serious problems with the process of warning at-risk persons



**FIGURE 1—Date respondents in Georgia first heard the warning about an outbreak of *Salmonella* infections (n = 124) and dates of news reports about the outbreak in the Georgia media that are summarized in the NEXIS database (n = 64).**

not to eat the food implicated in a large nationwide outbreak of *Salmonella* infections. We do not know of any other study of the effectiveness of a warning among an at-risk population about a foodborne outbreak. In Georgia, although most respondents had heard about the outbreak, the warning was neither as timely nor as convincing as we would have hoped. Customers first heard the warning a median of 5 days after it was issued, and although we began interviewing customers 13 days after it was issued, 9% of

our respondents were still not aware of the problem.

Many customers misunderstood or were skeptical of the warning. After first hearing the warning, 36% of the respondents did not understand that the implicated ice cream should not be eaten. Respondents who had heard the warning were no less likely than others to still have implicated products at home. Worse, in 31% of the households that had implicated products, a member of the household had eaten the product after hearing

**TABLE 1—Media Through Which Respondents Heard About the Warning on Contaminated Ice Cream Products and Median Date of First Hearing: Georgia, October 20–24, 1994**

Medium	Respondents Who First Heard Through Medium		Median No. of Days After October 7 Warning That Respondent First Heard	No. of Respondents Who Remembered Date They First Heard	Respondents Who Ever Heard Through Medium	
	No.	%			No.	%
Television news	93	(57)	4	65	130	(80)
Friend/family member	27	(17)	4	23	60	(37)
Local newspaper	16	(10)	5	13	50	(31)
Schwan's route driver	15	(9)	6	15	81	(50)
Radio	9	(6)	3	5	32	(20)
Letter from Schwan's	2	(1)	8	2	34	(21)
Doctor/health worker	0	(0)	...	...	1	(1)

*Note.* Of the 179 respondents interviewed, 163 had heard about the warning before the interview. The denominator used in calculating percentages was either 163 or 162 because of missing data.

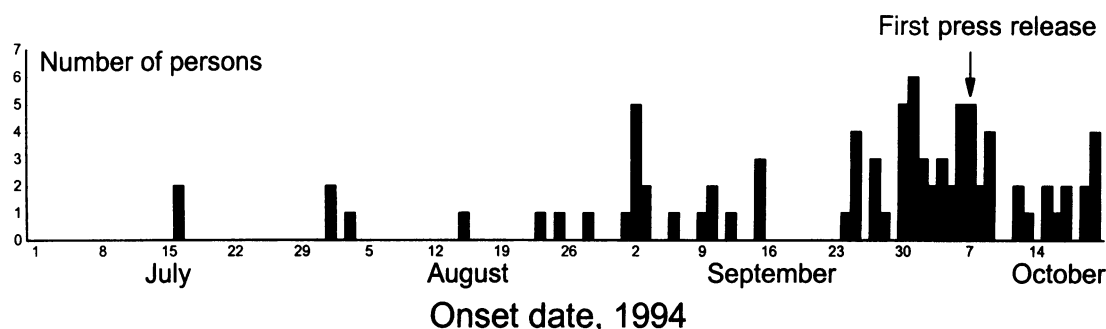


FIGURE 2—Dates of onset of diarrheal illness in Georgia consumers of implicated ice cream products, July–October 1994 (n = 85).

the warning, usually not believing that it was unsafe. Although some at-risk persons may always be hard to reach or convince, the high failure rate of this warning raises concern about the delivery of urgent public health messages.

We tried to identify aspects of the delivery of this warning that might indicate how communication could be improved. Although the news media, especially television, reached most people first, only 6% of Georgia news reports in NEXIS stated that the implicated products should not be eaten. Most reports focused on ill persons and on the ongoing investigation of the source of contamination. This focus on stories with “news value” rather than on risk education is characteristic of reporting on outbreaks and other hazards,<sup>11–13</sup> but it is not ideal for delivery of a public health warning. We do not know whether public health officials may have missed opportunities in press interviews to emphasize that customers should not eat the implicated products or whether greater emphasis could have led to greater coverage.

Schwan's delivery of the warning was also suboptimal. Although Schwan's reported mailing letters to all customers, only 21% reported receiving a letter, and those who had received a letter were no less likely than others to still have implicated products in the home. Similarly, only 50% of respondents reported being contacted by a driver; drivers evidently implemented the recall inconsistently, since 14% of households that reported hearing the warning from a driver still had implicated products. Anecdotal, although some respondents told us that their driver had made special efforts to deliver the warning quickly, others said their driver never mentioned it. The discrepancies between Schwan's statements and customers' reports could be explained by slow or incomplete implementation by the company or by customers' forgetting contacts;

regardless, the result was ineffective delivery of the warning.

This study also shows that what Schwan's Georgia customers didn't know did hurt them—a large outbreak appears to have occurred in this population. Reported diarrhea peaked in early October 1994, as in Minnesota and other states<sup>5</sup>; the decline in mid-October argues against recall bias as the reason for the peak. Persons who ate implicated products had a significantly increased incidence of reported diarrhea, independent of whether the respondent had heard the warning. A fully effective warning might have prevented much of this illness; eating implicated products after the warning was first issued could have been responsible for 16% of the reported diarrhea.

Routine surveillance in Georgia detected only one *Salmonella* serotype Enteritidis infection during the outbreak, perhaps in part because most of the illnesses were mild. Similarly, the Centers for Disease Control and Prevention received no reports of deaths associated with this outbreak. However, these data also point out the insensitivity of *Salmonella* surveillance systems even in large outbreaks. Schwan's would not release national product distribution data; however, 2% of wholesale distributors who received recalled ice cream had Georgia addresses. If Georgia received 2% of the contaminated products, the number of cases nationwide could be roughly estimated at about 550 000 (11 000 cases/2%)—in the same range as the more precise estimate of 224 000 cases calculated by Hennessy et al.<sup>5</sup> The corresponding reporting rate of less than 1% (593/550 000) is consistent with the 0.3% estimated by Hennessy et al.; both are even lower than the 1% to 5% rate for *Salmonella* infections estimated previously.<sup>14</sup>

The lessons learned during this investigation may be helpful in future outbreaks. The media, especially television, get the word out quickly but may not focus on the public

health message. Word of mouth from friends and family members can effectively communicate a risk warning. Individual contacts through visits, letters, or telephone calls are slow but may reach persons who would not be reached by other means. It is often appropriate for a company to take responsibility for certain communications to its customers; public health workers should help ensure the thoroughness of those communications and of the retrieval of contaminated products.

Our investigation also highlights the need for further research on methods for delivering effective warnings. We are aware of only 4 other investigations on warnings during acute outbreaks; all showed that communication to the target population was late, incomplete, or inaccurate,<sup>15–18</sup> and none were able to study possible ways to improve communication. The potential for outbreaks affecting large numbers of persons continues to increase; the need to rapidly and effectively warn consumers of an acute health threat is a challenge we are likely to face again. □

## Contributors

Dr Mahon organized the study, supervised data collection, did the preliminary analyses, and was the primary writer of the paper. Dr Slutsker and Dr Griffin closely supervised the entire project, directed the focus of the investigation, and contributed substantially to writing the paper. Dr Drenzek participated in study design and data collection and analysis; she also participated in writing and reviewing the manuscript. Dr Toomey collaborated with the CDC authors in designing the study, assisted with organizing the data collection, and participated in writing and reviewing the manuscript. Ms Hutwagner and Ms Maloney reviewed the primary data and the univariate analyses, conducted the generalized estimating equations analysis, wrote the statistical portions of the manuscript, and reviewed the entire paper.

## Acknowledgments

We thank Ms Onnalee Henneberry of the CDC for conducting the NEXIS search and Drs Luis

Castellanos, Laurie Elam-Evans, Clarice Green, and Judith Moore of the CDC and Ms Barbara Carmichael, Mr Thomas Mortar, and Mr Wayne Moy of the US Food and Drug Administration for conducting customer interviews.

## References

1. Tauxe RV. *Salmonella*: a postmodern pathogen. *J Food Protection*. 1991;54:563-568.
2. Hedberg CW, MacDonald KL, Osterholm MT. Changing epidemiology of food-borne disease: a Minnesota perspective. *Clin Infect Dis*. 1994;18:671-682.
3. Bean N, Griffin P. Foodborne disease outbreaks in the United States, 1973-1987: pathogens, vehicles and trends. *J Food Protection*. 1990;53:804-817.
4. Blaser MJ. How safe is our food? Lessons from an outbreak of salmonellosis. *N Engl J Med*. 1996;334:1324-1325.
5. Hennessy TW, Hedberg CW, Slutsker L, et al. A national outbreak of *Salmonella enteritidis* infections from ice cream. *N Engl J Med*. 1996;334:1281-1286.
6. St. Louis ME, Morse DL, Potter ME, et al. The emergence of grade A eggs as a major source of *Salmonella enteritidis* infections. New implications for the control of salmonellosis. *JAMA*. 1988;259:2103-2107.
7. Pavia AT, Tauxe RV. Salmonellosis: nontyphoidal. In: Evans AS, Brachman PS, eds. *Bacterial Infections of Humans*. 2nd ed. New York, NY: Plenum Medical Book Company; 1991: 573-591.
8. *Epi Info* [computer program]. Version 6. Atlanta, Ga: Centers for Disease Control and Prevention; 1994.
9. Karim MR, Zeger SL. *GEE: A SAS Macro for Longitudinal Data Analysis*. Baltimore, Md: Johns Hopkins University; 1988. Technical report 674.
10. Liang KY, Zeger SL. Longitudinal data analysis using generalized linear models. *Biometrika*. 1986;73:13-22.
11. Singer E, Endreny PM. *Reporting on Risk. How the Mass Media Portray Accidents, Disasters, and Other Hazards*. New York, NY: Russell Sage Foundation; 1993.
12. Pennington TH. Necrotising fasciitis: quantitative characteristics of the 1994 British media outbreak. *J Infect*. 1995;30:63-65.
13. Glanz K, Yang H. Communicating about risk of infectious diseases. *JAMA*. 1996;275:253-256.
14. Chalker RB, Blaser MJ. A review of human salmonellosis, III: magnitude of *Salmonella* infection in the United States. *Rev Infect Dis*. 1988; 10:111-124.
15. Freeman RC, French JF. What is the addicts' grapevine when there's "bad dope"? *Public Health Rep*. 1995;110:621-624.
16. Loutan L, Robert C-F, Raebler P-A. Outbreak of yellow fever in Kenya: how doctors got the news. *Lancet*. 1993;341:1030.
17. Thomson APJ, Hayhurst GK. Press publicity in meningococcal disease. *Arch Dis Child*. 1993; 69:166-169.
18. Angulo FJ, Tippen S, Sharp DJ, et al. A community waterborne outbreak of salmonellosis and the effectiveness of a boil water order. *Am J Public Health*. 1997;87:580-584.

## Planning for Community-Oriented Health Systems

by James E. Rohrer, Ph.D

**T**his book shows how public health systems and medical care can create integrated partnerships that will enhance the quality and economy of both while delivering care that meets community needs.

### Important information for:

□ State/local health agency personnel □ Health administrators □ Managed care administrators and physicians □ Community hospital planners. This book provides a definition of community-oriented health systems and will aid in empowering communities as they seek to protect and enhance community health and quality of life in the face of declining medical care revenues. As managed care systems spread across the country, the need for community health planning has increased. A process for clarifying needs and goals is essential.

### Chapters include:

□ Planning Doctrine □ Designing Community Health Systems □ Assessment of Community Needs □ Measuring Health System Performance □ Monitoring the Quality and Appropriateness of Health Services □ Prospects and Training. The appendix includes a practical community health needs assessment survey that you can use as a model to begin your community health planning project right away.

1996 • 168 pages • softcover • ISBN 0-87553-230-6



American Public Health Association • Publication Sales  
P.O. Box 753 • Waldorf, MD 20604-0753  
Tel: 301/893-1894 • Fax: 301/843-0159